Vol.7 No.1 (2024)

Journal of Applied Learning & Teaching

ISSN : **2591-801X**

Content Available at : **http://journals.sfu.ca/jalt/index.php/jalt/index**

Artificial Intelligence (AI) in academic research. A multi-group analysis of students' awareness and perceptions using gender and programme type

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Keywords

Artificial intelligence;
awareness;
multigroup analysis;
perception;
structural equation modelling;
utilisation.

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Article Info

Received 7 December 2023
Received in revised form 20 December 2023
Accepted 4 January 2024
Available online 22 January 2024

DOI: https://doi.org/10.37074/jalt.2024.7.1.9

Abstract

The era of AI has brought tremendous impact in academic research, and this has provided the impetus for students to leverage on novel tools in carrying out a lot of quality research works. Previous studies have relied so much on AI for instruction, classroom management and assessment and utilisation of AI tools for research has scarcely been examined. This study covered the gap by examining students' utilisation of AI tools based on their level of awareness and perception and finding out the difference based on gender and programme type in such prediction. A total of 5554 university students were used for the study. Exploratory factor analysis was first carried for dimensionality and other validity checks (convergent and discriminant) using Average Variance Extracted (AVE) and Fornel-Larcker criterion and methods. Population t-tests and multi-group analyses were performed using SPSS and Smart PLS 3. The study found that students have high level of awareness and positive perception of AI tools in research. Similarly, the level of utilisation of AI tools in research is high. Male and postgraduate students have a higher level of awareness and positive perception of AI tools in research, with female students stronger than male students in terms. Perception and awareness directly impacted on utilisation but perception mediates positively and significantly in the nexus between awareness and utilisation. The study findings provide useful insights into using AI tools among university students and also identify the rationale to consider variables like gender and programme type when developing curriculum that will meet the current technology needs in our higher institutions.

Introduction

Technology in research has been a product of recurrent invention, but in recent years, AI, which performs cognitive tasks that are problem-solving-oriented, has been commendable (Bonk & Wiley, 2020). The term *AI* is a conglomeration of different analytical methods classified as machine learning, neural networks, and deep learning (Alloghani et al., 2020; Popenici & Kerr, 2017; Aggarwal, 2018). Each of these concepts has a function it plays. For example, machine learning is programmed with the internal capacity to make decisions through supervised or unsupervised learning models.

The benefits of AI in educational circles and research have been well documented in previous studies. For example, it is stated that AI technology like chatbots is used for review of literature (Clark, 2020), intelligent tutoring and automated data collection (Heffernan & Heffernan, 2014), student collaboration and personalisation of learning experiences (Luckin et al., 2016; Chiu et al., 2022; Mertala et al., 2022), monitoring progress of a work (Swiecki et al., 2019), automated data collection and analysis (Okada et al., 2019; Vij et al., 2020; Yuan et al., 2020), profiling respondents' background (Cohen et al., 2017), as well as analysis of data using different statistical packages (Owan et al., 2023). Other areas are AI tools like ChatGPT that have the internal capacity to assist students and researchers, in areas which include writing tasks, text generation, language translations, and responding to academic queries (Dwivedi et al., 2023; Kasneci et al., 2023; Lund et al., 2023). Similarly, AI utilisation in academic research is effective in assisting students to review literature, overcome barriers in English, usually from those of a non-English speaking background, summarise papers, identify gaps for reviews, and generate drafts of research papers (Rahman et al., 2023; Gao et al., 2022; Rudolph et al., 2023a).

Until recent, many scholars have agreed that AI tools are powerful in improving students writing skills (Zhao, 2022; Kurniati & Fithriani, 2022; Wang, 2022) while others have noted that even though it is very important in improving students' skills, its side effect is considered very paramount (Lund & Wang, 2023; Qadir, 2022; Liu et al., 2022). Given the relevance of AI in research, one anticipates that students' utilisation of this technology in their academic research activities will be maximised. Similarly, their perception will be positive. However, the utilisation of AI is below expectations among students, unlike what it is used for in other areas like instruction, assessment, and instructional delivery (Ismail et al., 2022), and most students' perceptions are negative (Elliott & Soifer, 2022; Hu & Min, 2023; Saura et al., 2022). The utilisation of AI in research cannot be achieved where students, academic staff, and stakeholders in higher institutions of learning are not concerned with the creation and integration of AI at various levels of instruction (Langran et al., 2020; Qin et al., 2020). The utilisation of AI in research requires that students acquire the skills and knowledge that will make them aware of its diverse applications as well as develop a positive perception of the role it plays in research (Seufert et al., 2020; Häkkinen et al., 2017).

The research effort remains unclear to this point. The researchers are not very exact on the level of utilisation of AI in research in Nigeria. This leaves the quality of work done in doubt because artificial intelligence has proven to be a veritable tool for excellent research outcomes. Admittedly, most of the existing studies look at the utilisation of AI for instruction in the educational circle and, specifically, its impact on international students' success (Wang et al., 2023) and the effectiveness of teaching (Almelweth, 2022). Other scholars have looked at AI in education and schools (Ahmet & Aydemirb, 2020; Chen et al., 2023), predicting the impact of AI on performance (Khan et al., 2021), and the challenges of AI for teachers (Ismail et al., 2022). However, the utilisation of AI among students for academic research has not been extensively explored.

Recent studies have tried to bridge the gap. Scholars like Adiguzel, Kaya, & Cansu (2023) studied revolutionising education with AI: Exploring the transformative potential of ChatGPT. The Chubb, Cowling, and Reed (2022) study appears to be the most recent and closely related to this study. The study focused primarily on the effect of AI on research practices and culture, using areas such as thematic analysis and deductive analysis to uncover issues affecting university staff. Besides, the utilisation of AI in research involves the engagement of different AI tools such as SciSpace, Schoarlcy, Jenni AI, ChatPDF, Paperpal, Casper, Grammarly, QuillBot, Turnitin, Elicit, Lateral, ClioVis, Glasp, Audiopen, Search Smart, Consensus, and Mendeley, among others (Huang et al., 2023b; Nazaretsky et al., 2022; Adiguzel et al., 2023). Thus, students' use of artificial intelligence tools for instruction and assessment is not the same as that used for review of literature, summarisation of studies, data analysis, plagiarism checks, and report writing. Further still, Bingimlas (2009) noted that students' utilisation is basically based on their level of awareness, perception, and access to machines that can be useful in their research endeavours. Similarly, students' level of awareness cannot be unconnected to the single fact that AI tools were not emphasised in African universities as compared to other universities in the world. Most of these tools were used in most international universities (Mogavi et al., 2023), and the paucity of conversation regarding the application of AI is germane for a study of this nature (Agyemang et al., 2023). Therefore, this study is imperative to guide policymaking in Nigeria and other developing nations.

Literature review

Previous studies have been conducted on the utilisation of artificial intelligence in higher education (Liang et al., 2021; Hwang & Tu, 2021). In fact, since the inception of ChatGPT in 2004, there has appeared to be a paradigm shift in the number of studies in relation to ChatGPT, generative AI, and higher education. Studies on AI in relation to higher education are many (Limna et al., 2023; Xames & Shefa, 2023; Crawford et al., 2023; Ifelebuegu et al., 2023; Popenici et al., 2023; Adarkwah et al., 2023). For example, the Rasul et al., (2023) study found that AI is beneficial to higher education students in that it helps facilitate adaptive learning, personalised feedback, assessment, support research and data collection and analysis, as well as

automated management services. The study also found that research in areas of higher education is affected by issues of reliability, limitations in skill acquisition, academic integrity, and falsification of information. What has not been explored extensively is the utilisation of AI tools by university students in research. Studies that exist are few. Gasaymeh (2018)'s study showed that students own laptops and smartphones, which provide easy access to the utilisation of ICT in educational activities. The study also found that students' utilisation of ICT is high. However, the use of ICT may not necessarily mean AI because there are so many ICT facilities that students utilise, which may not be artificial intelligence tools.

The awareness of students of AI tools in research has been an issue of great concern among scholars since a variety of tools are available in research. This is because how students perceive and utilise the research tools that AI provides is crucial in developing good and quality work that meets global standards. Similarly, the awareness of AI tools among students is crucial to measuring how well they are prepared to utilise emerging technologies that are impactful in society. Gradually, students' perception of AI is changing. In fact, most students who were hostile to AI tools have gradually understood the importance of AI applications in their research studies and expressed optimism about AI assistance in various disciplines (Li, 2020; Miranty & Widiati, 2021; Fahmi & Cahyono, 2021). Kelly et al. (2023)'s study found that awareness differs across subgroups and disciplines. Other studies have also shown that students' level of awareness is very high, especially with ICT and manipulation of the social media space (Dessy Harisanty et al., 2022; Khanagar et al., 2021). Yelena et al. (2022)'s study found that students' level of awareness is low. The mixed-methods research demands that we provide empirical evidence that will further assist in decision-making. It is imperative that a further study that will provide more explanation for these lessons be provided, especially in Africa, where AI is still not adequately utilised among students.

Students' perceptions of AI tools in research have generated diverse opinions, primarily because many students express ethical concerns regarding the integration of AI within educational settings (Kung et al., 2023). However, research indicates a positive reception among students regarding the use of AI in research writing. This positive outlook is closely linked to their acknowledgment of the user-friendly interface of these tools and their capability to furnish additional materials that facilitate a deeper understanding of the subject matter studied (Arguson, et al., 2023). Other researchers have also focused on the awareness of the efficiency of AI in educational setups (Liang et al., 2021; Hwang & Tu, 2021; Ouyang et al., 2022; Chu et al., 2022). These studies found that AI has been very applicable in online higher education in terms of predictive performance, improvement of learning experiences, and automated assessment. Others still noted that AI in higher education is basically in areas like assistive technology, predictive modelling, content analysis, and image analytics (Yang, 2022; Hinojo-Lucena et al., 2019). The application of AI in research is minimal, and there is no universal agreement among scholars on the nexus between awareness and perception of the utilisation of AI tools in academic research. Almaraz-López, et al. (2023) studies found that students are aware of the impact of AI and are willing to utilise it in education. However, the study was silent on their perception of AI tools. Syed and Al-Rawi (2023) found that 73% of university students have knowledge of AI, 69.4% thought it was applied only in health care, and 57.3% were aware of the impact of AI, but perception of AI was found to relate positively with year of study and nationality. Moreover, the study aligns with previous studies that attempted to show that when students perceive that the tools are suitable for their development, it enhances their utilisation at any level (Lund et al., 2023). These insights, therefore, underscore the connection between awareness, perception, and utilisation of AI tools.

However, gender studies have been carried out in different studies, especially as it concerns ICT usage and social media engagements (Owan et al., 2023). Most of the studies found gender to be non-significant in respect of awareness, perception and utilisation of technology. Contrary to this, there are other studies that do not state that the level of awareness of AI among students is significantly different between male and female students. Alimi et al.'s (2021) study found that the majority of tertiary institution students are not aware of the application of AI in learning and research and that both male and female students' levels of awareness of the use of AI are not different. Agyemang et al. (2023) found that 50 academics confirmed minimal awareness of ChatGPT. The findings of the study could be connected to the perception many students and staff have concerning AI, which has affected their utilisation. Syed and Al-Rawi's (2023) study found that student's level of awareness of AI is high and that they hold a positive perception about the concept, benefits, and implementation of AI tools in research. However, the negative challenge that some of the participants hold is basically a function of the manipulation of the tools, which they perceive as relevant but possess inadequate skills to operate.

The increasing utilisation of artificial intelligence has escalated the awareness of students, both male and female, but male students are often identified as being more aware than female students (McGregor et al., 2017; Odigwe & Owan, 2020). This concurs with previous studies conducted in Africa that posit that male students are more aware than female students of their engagements on the internet and utilisation of instructional technologies (Owan et al., 2023). Another study found that male students do not differ from female students in their perception of AI tools in research (Syed & Al-Rawi, 2023). In terms of utilisation, there are confusing reports of genders that use more ICT than others (McGregor et al., 2017). This is because there are some studies that tend to establish that in surfing the net, engaging in media charts, and being present in the cyberspace, no significant difference exists between males and females (Mesagan et al., 2022). The perception of students towards AI tools may concern data privacy and ethical implications. Further studies are necessary to examine these concerns so as to help students embrace emerging technologies.

In Nigeria, the study by Alimi et al (2021) revealed that students' level of awareness of AI tools is high. However, gender differences do not exist in awareness and utilisation of AI tools for learning. It is evident that most studies have

been able to establish the different rates of AI tool adoption in different academic research. However, there remains a need for a deeper analysis of the various factors that influence these discrepancies. Understanding why certain attributes like gender and programme type are important is necessary to tailor efforts and interventions in order to bridge the gaps. The use of AI in academic research and activities is a novel idea, especially in Africa. Most of the students do not have any fundamental knowledge of AI in their training as it is not part of the curriculum. In most cases, students are exposed to ICT programmes that only cover Microsoft Office applications and a little programming. Therefore, their knowledge of AI tools and their applicability could differ by programme type and discipline (Kasneci et al., 2023). There are insufficient studies that examine the differential variations between undergraduate and postgraduate students in relation to the level of awareness, perception, and utilisation of AI tools in research.

Currently, there is a need for an in-depth examination of research activities in the era of AI. This is because there are so many AI tools that are valuable in research activities. Students' non-use of AI tools in research could have a serious effect on the quality of the research outcome. For example, most students claim that they have not seen adequate literature on a particular area of interest. This could probably be due to their perception or limited knowledge of the various stools that are applicable to research. The recent study that was carried out in Saudi Arabia by Syed and Al-Rawi (2023) on perception, awareness, and opinion towards AI was more descriptive and only attempted to provide first-hand information on the characteristics of students with respect to how they conceive AI in their studies. These studies approach the issues from a bibliometric perspective. No study has been done to evaluate the awareness, perceptions, and utilisation of AI tools in research using a multi-group analysis technique. The rationale is that most universities in Africa still utilise traditional methods for conducting research. The level of digital materials that are necessary and required for full application of AI is not yet available, and lecturers too may not be aware of the diverse AI tools that can facilitate quality and efficient outcomes.

It is this literature that has provided the basis for formulating the hypotheses to unearth the intricate relationship existing between variables when certain factors like gender and programme type are involved.

i. The extent of student's awareness of AI tools in academic research is not significantly high.

ii. Students' perception of AI tools in academic research is negative.

iii. There is a low level of student's utilisation of AI tools in academic research.

iv. Students' level of awareness does not have a significant direct effect on their perception to AI tools engagement in academic research.

v. Students' level of awareness does not have a significant direct effect on the utilisation of AI tools in academic research.

vi. Students' perception does not have a significant direct effect on the utilisation of AI tools in academic research.

vii. The relationship between awareness and utilisation of AI tools in research is not mediated by students' perception of AI tools.

viii. The direct effect of awareness on perception of AI tools in research is not significantly different between male and female students.

ix. The direct effect of awareness on utilisation of AI tools in research is not significantly different between male and female students.

x. The direct effect of perception on utilisation of AI tools in research is not significantly different between males and females.

xi. The mediating effect of perception on awareness on the utilisation of AI tools in research is not significantly different between male and female students.

xii. The direct effect of awareness on the perception of AI tools in research is not significantly different between undergraduate and postgraduate students.

xiii. The direct effect of awareness on the utilisation of AI tools in research is not significantly different between undergraduate and postgraduate students.

xiv. The direct effect of perception on the utilisation of AI tools in research is not significantly different between undergraduate and postgraduate students.

xv. The mediating effect of perception in linking awareness to the utilisation of AI tools in academic research is different between undergraduate and postgraduate students.

Conceptual framework

The conceptual framework presents the interlinkage of the variables with each other pictorially. This is presented in Figure 1.

Methodology

The study is based on the positivist theory of research, which relies heavily on quantitative approaches. The study adopted a cross-sectional survey design. The cross-sectional design was applicable in the study since it only attempts to uncover associations by gathering data at a point in order to provide insight into the nature of the relationships. The study focused basically on the association between perception, awareness, and willingness for students' utilisation of AI tools for academic research. No attempt was made to manipulate the variables since it is a non-experimental study.

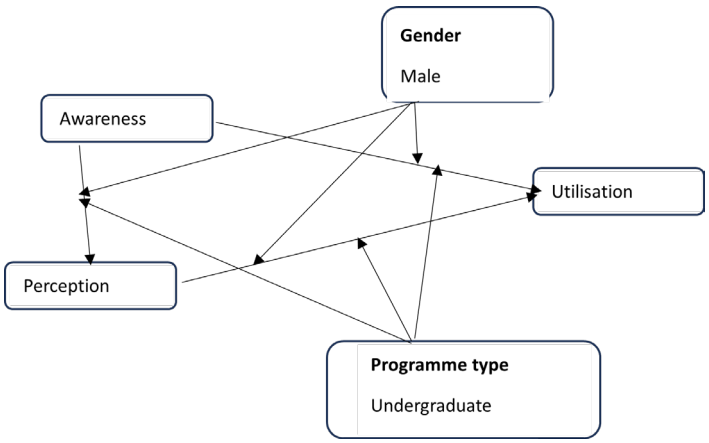

Figure 1: Conceptual model of the study.

The study participants were made up of final-year students in six universities in the study area, as well as master's and doctorate students who are in their second and third years of programmes respectively. These sets of students were selected because they are involved directly in writing their projects, theses, or dissertations. However, the eligibility criteria for selection were that the students' work must be quantitatively inclined since most of the tools in AI for researchers are both qualitative and quantitative. The study involved 5554 students. The demographic attributes of the students are that 3021 (54.39%) are male students, while 2533 (45.61%) are female students. In terms of programme type, 3232 (58.18%) are undergraduate students, while 2322 (41.82%) are postgraduate students. Similarly, 2102 (37.84%) are married, 2953 (53.17%) are single, and 499 (8.98%) are either divorced or widowed. The descriptive analysis also showed that 2611 (48.81%) are below 30 years, 2451 (44.13%) are between 30 and 50 years, while 492 (8.85%) are above 50 years.

Instrument and measures

There are basically five measures in this study. These are gender, programme type, awareness, and perception of students, as well as the utilisation of AI tools in research. In this context, gender is defined as the biological characteristics that separate the male from the female. Programme type is the programme that the students are enrolled in, either as undergraduate students or postgraduate students. Awareness in this contest is operationally defined as students' knowledge of the various AI tools that are used in research. Perception refers to the feeling or mindset that is either negative or positive that students hold about AI tools that are available to assist in research work. Utilisation of AI tools refers to the actual engagement of the plethora of available tools in doing research work by students. The instrument was divided into three sections. Section A was designed to provide demographic information about the respondents, such as gender, age, and programme type. Similarly, the section provided the opportunity for students to state their intention to participate in the study by ticking the check box provided in the section. This is after a cover letter was first made stating the objectives of the study, the confidentiality involved in the study, the need to provide objective responses, and how respondents' responses will be protected from third parties. Options concerning gender, which was categorised as male and female, as well as type of programme, which was categorised as undergraduate and postgraduate, were provided in Section A.

Section B elicited responses on students' awareness and perceptions of the utilisation of AI in research works. This section, for clarity, was divided into two parts, such as awareness and perception. Awareness was measured with 7 items, with a sample item as "I am aware that AI tools can be used for literature reviews". Similarly, for perception of AI tools in research, 7 items were used for the study, and one sample item is "I sometimes feel that using AI for research is very unethical". These responses were to be obtained using a four-point Likert-modified option of strongly agree to strongly disagree. Section C was to elicit information on the utilisation of AI tools for research. This was done by listing the various AI tools that are necessary for research, and the respondents were to state the extent to which they have used the tools in their research work. On a linear scale of four-point response, the respondents were to indicate whether they had utilised the tool or not. Ten of the tools of AI that were featured include SciSpace, Schoarlcy, ChatGPT, Paperpal, Grammarly, QuillBot, Turnitin, Elicit, Consensus and Mendeley.

Content validity

The content validity was carried out quantitatively using experts in diverse fields. Seven experts were selected from educational technology, measurement, and evaluation. These experts have high reputations in instrument development and analysis and have been in the field for the past ten years. Similarly, all those used in this study are professors in their respective disciplines. A total of 30 items were initially developed after an extensive review of the literature to identify what could constitute the domains of the variables. After initial screening, the initial pool of 36 items was reduced to 24 items that were considered suitable, relevant, and specific for the study. The decisions of the experts were based on an acceptable range of item-content validity indices (I-CVI) of 0.77 to 0.90 (for suitability), 0.78–0.99 (relevance), and 0.88–0-98 (precision). Items whose index was below 0.70 were reviewed for either clarity, relevance, precision, or both. This suggestion is in line with experts' opinions (Zamanzadeh et al., 2015). Similarly, for scale content validity indices (S-CVI), they ranged from 0.93-0.96, 0.91-0.94, and 0.90-0.98, respectively, for suitability, relevance, and precision. This helped to reduce the number of items from 24 to 20 based on the analysis as well as the comments by the experts in the comment form provided by the researchers to the evaluators.

Preliminary analysis

The final draft was assembled that will be used for data collection. A total of 450 undergraduate and postgraduate students were selected for the pilot study. The selection of this number was based on the recommendation by various scholars that, in a survey, a ratio of 10:1 is enough to have a large sample (see Boateng et al., 2018). Thus, of the 24 items

for this exercise, 450 are considered adequate by this rule of thumb. The instrument was mailed to the respondents, and after five months (December 2022 – April 2023), the respondents had finished responding as expected, but only 5420 responses were obtained for the preliminary studies.

Exploratory factor analysis was carried out using the data obtained with varimax rotation based on maximum likelihood extraction techniques. A total of six factors were obtained from the initial analysis. However, some items were dysfunctional in that they loaded alone; some loaded in more than one factor, while others had factor loadings less than 0.30. These items were deleted, after which the remaining 15 items were loaded appropriately based on three factors. The three factors obtained, as presented in Table 1, explained a cumulative of 67.352% variance squared loadings. Each factor contributed to the total variance extracted. The utilisation of AI contributed 27.831% of the variance, the second factor (awareness of AI tools for research) contributed 22.964%, and the third factor (perception of AI tools for research) contributed 16.557% to the total variance. The KMO test of sampling adequacy yielded a coefficient of 0.794, while the Bartlett's test of sphericity yielded a significant result, $\chi 2(105) = 3857.045$, $p < .001$, indicating that the correlation matrix was not an identity matrix and that the sample size of 420 was adequate or sufficient for the performance of factor analysis.

To establish discriminant and convergent validity, the study followed the suggestion of the Fornell-Larcker criterion (Fornell & Larcker, 1981) that relies mostly on the average variance extracted (AVE) and the composite reliability measures to determine these qualities. According to the scholars, where the AVE for each subscale is greater than 0.50, such measures are accepted as adequate for convergent validity, and where the square root of the AVE is greater than the inter-construct correlation coefficient of each of the subscales, it is established that discriminant validity exists. When these occur, it is always an indication that items could separate themselves from unrelated variables (Fresco et al., 2007; Patterson et al., 2005). The result in Table 1 presents the factor loadings of each item, the average variance extracted (AVE), composite reliability and discriminant validity of each factor.

Table 1: Exploratory factor analysis and internal structure of the scale to show dimensional evidence.

Items	M	SD	ε	λ	λ^2	Construct attributes
UTI1	2.0690	.33491	.01634	.860	.740	
UTI3	2.0905	.36741	.01793	.826	.682	AVE= .606
UTI5	2.0024	.55915	.02728	.769	.591	Discrim=0.778
UTI9	2.0548	.28377	.01385	.739	.546	α=.760
UTI8	1.5405	.64868	.03165	.736	.541	
UTI4	2.0929	.33627	.01641	.733	.537	
SUM	**11.8500**	**1.97934**	**.09658**	**3.927**	**3.637**	
AWR1	2.6976	.75145	.03667	.851	.724	
AWR4	2.7071	.64991	.03171	.824	.679	AVE=0.563
AWR6	2.7262	.69350	.03384	.787	.619	Discrim=0.750
AWR3	2.7833	.73326	.03578	.703	.494	α=.701
AWR2	2.7833	.72012	.03514	.688	.473	
AWR5	2.7286	.76476	.03732	.627	.393	
SUM	**16.4262**	**3.24450**	**.15832**	**4.480**	**3.382**	
PER1	2.1071	.30966	.01511	.958	.918	
PER2	2.0905	.28720	.01401	.938	.879	AVE=.870
PER5	2.1310	.33775	.01648	.902	.813	Discrim= .933
SUM	6.3286	.88296	.04308	2.798	2,610	α=.779

AVE=average variance extracted, Discrim=Discriminant validity, α=Cronbach alpha

Ethical consideration

The researchers had earlier explained in Section A of the questionnaire that participation in the study is voluntary. Options were also given for those who were not interested to tick appropriately. However, the study is a survey, and it does not cause any harm to subjects since none were subjected to any conditions. According to the Federal Ministry of Health (2007), ethical clearance can be waived. In spite of that, the respondents were made to tick the check box provided to indicate their willingness to participate in the study. In this way, consent was obtained by the respondents by writing to the researchers in the column provided in the questionnaire. The respondents were told that the responses would be used for publication in journal articles and that the information provided would be treated with a high level of confidentiality, to which no third party would have access without their consent. All those who had provided consent to this study were the respondents who finally responded to the questionnaires.

Procedure for data collection

The data collection was done by sending a copy of the questionnaire electronically to the participants. This was done by engaging 40 research assistants who were financially motivated to support the team of researchers. The number of research assistants were high because of the large number of respondents in this study. The researchers were aimed at avoiding potential bias in the study. Each of the assistants was led by a principal author in this study. The researchers visited 6 universities in two geopolitical zones (South-South and South-East). The researchers were able to gain access to student union government leaders at the undergraduate and postgraduate levels. This helped to contact class representatives from various departments who are at their final year level and are writing research reports. These class representatives, based on their agreements, were added to the Telegram group created for this data collection. They were to share the instrument with their various class groups for the students to respond to it. They were, however, mandated to avoid sending the links to other forums that are not their class to avoid responses from those who do not constitute the frame of this study. The administration and collation of responses took about 8 months for the CVS file to be completed. However, a total of 5420 responses were downloaded, which indicated that this was the number that returned and took part in the study.

Results/findings

Hypothesis One was tested using a population t-test to determine the level or extent of students' awareness of the use of AI tools in academic research. The result showed that the mean score of students' awareness of AI tool research is ($M = 14.04$, $S.D. = 2.81$) at a 95%CI [13.9678, 14.1175], $t(5419) = 367.823$, $p<.001$. This showed that students' awareness of AI tools in research is significantly high. The alternate hypothesis is supported. Male students had a higher mean value ($M = 14.60$, $SD = 1.58$) of awareness of AI tools for research than the mean of female respondents

(M = 13.76, SD = 3.21), with a significant mean difference of -.840 and a 95%CI of [-.995, -.6880], t (5418) = 25.67, p.05. The study found that awareness of AI tools is stronger for male respondents than female respondents. Similarly, respondents who are postgraduate students have a stronger mean value (M = 15.42, SD = 2.87), compared to undergraduate students (M = 12.82, SD = 2.09), with a significant mean difference of -2.60 and a 95%CI of [-2.74, -2.47], t (5418) = -38.400. This showed that awareness of the utilisation of AI tools in research is stronger among postgraduates than among undergraduate students.

Hypothesis Two: Students perception of the use of AI tools in research

Hypothesis Two was tested using a population t-test to determine the extent of students' perceptions of the use of AI tools in academic research. The result showed that the mean score of students' perception of AI tool research is (M = 10.221, S.D. = 1.794) at a 95%CI [10.221, 10.317], t(5419) = 421.349, p<.001. This showed that students' perceptions of AI tools in research are positive. The alternate hypothesis is supported. Male students had a higher mean value (M = 11.393, SD = 1.227) of perception of AI tools for research than the mean of female respondents (M = 9.712, SD = 1.769), with a significant mean difference of -1.678 and a 95%CI of [-1.773, -1.590], t(5418) = -36.188, p<.05. The study found that male students have a more positive perception of AI tools than female students. Similarly, respondents who are postgraduate students have a relatively equal mean value (M = 10.22, SD = 1.750) compared to undergraduate students (M = 10.312, SD = 1.832), with a non-significant mean difference of 0.092 and a 95%CI of [-.092, -.188], t (5418) = 1.890, p >.001. This showed that the perception of AI tools in research is similar among postgraduate and undergraduate students and is positive.

Hypothesis Three: Students' utilisation of AI tools in academic research

Hypothesis Three was tested using a population t-test to determine the extent of student's utilisation of AI tools in academic research. The result showed that the mean score of the extent of students' utilisation of AI tools research is (M = 20.932, S.D. = 5.67) at a 95%CI [20.797, 21.06], t(5419) = 303.776, p<.001. This showed that students' utilisation of AI tools in research is significantly high. The alternate hypothesis is supported.

Female students had a higher mean value (M = 21.47, SD = 5.45) of utilisation of AI tools for research than the mean of male respondents (M = 19.845, SD = 1.769), with a significant mean difference of 1.626 and a 95%CI of [1.34, 1.91], t(5418) = 11.235, p<.05. The study found that female students have higher utilisation of AI tools than male students. Similarly, respondents who are postgraduate students have a stronger mean value (M = 24.41, SD = 5.01) compared to undergraduate students (M = 17.82, SD = 2.39), with a significant mean difference of -6.59 and a 95%CI of [-6.79, -6.39], t (5418) = -62.76, p<.001. This showed that the utilisation of AI tools in research is stronger among postgraduate students than among undergraduate students.

Test of prediction

The test of prediction was carried out using partial least squares (PLS) structural equation modelling to determine the contribution of student perception and awareness to the utilisation of AI tools in research. Similarly, mediation analysis was carried out using students' perceptions of the relationship between awareness and utilisation of AI research tools. Figure 2 shows that student awareness and willingness which collectively explain 11.7% of the variation in student utilisation of AI tools in research R^2 = 0.117, p<.05. Similarly, student awareness accounted for 3.8% of the variance in their student utilisation of AI tools in research, R^2= 0.038, p<.05. The f-square statistic shows that awareness and perception have significant effect sizes F^2 =.122, 95% [.08, .14], p<.001, 01. and F^2 =.095[.03,.07].07], p<.001 in predicting student utilisation of AI tools in research.

The result for Hypothesis Four as presented in Table 3 indicates a significant direct effect of awareness (β =.19, 95%CI [.13,.23], t = 8.022, p<.05) on perception of AI research tools. Therefore, Hypothesis 4 was supported. The result for Hypothesis 5 as presented in Table 3 showed a significant negative direct effect of awareness (β = −.0167, 95%CI [−.22, −.06], t = 4.263, p<.05) on the utilisation of AI research tools in research. Thus, Hypothesis 5 was rejected by evidence. Similarly, on the direct effect of perception on the utilisation of AI tools in research (Hypothesis 6), the result is presented in Table 3.

Table 2: Population and independent t-test analysis of students level of awareness, perception and utilisation of AI tools in research by gender and programme types.

Variables	Extent of variables perception, awareness and utilisation				Gender					Programme type				
	N	M	SD	t-cal	Males		Females		t-cal	Undergraduate		Postgraduates		t-cal
					M	S.D	M	S.D		M	S.D	M.	S.D	
Awareness	5420	14.04	2.81	367.82*	14.60	1.58	13.76	3.21	-10.42*	12.81	2.09	15.41	2.87	-38.40*
Perception	5420	10.26	1.79	421.34*	11.39	1.22	9.71	1.76	-36.18*	10.31	1.83	10.22	1.75	1.89
Utilisation	5420	20.93	5.07	303.77*	19.84	3.98	21.47	5.45	11.23*	17.82	2.39	24.41	5.01	-62.76*

*M=mean, SD=standard deviation, *=Significant at .05 level*

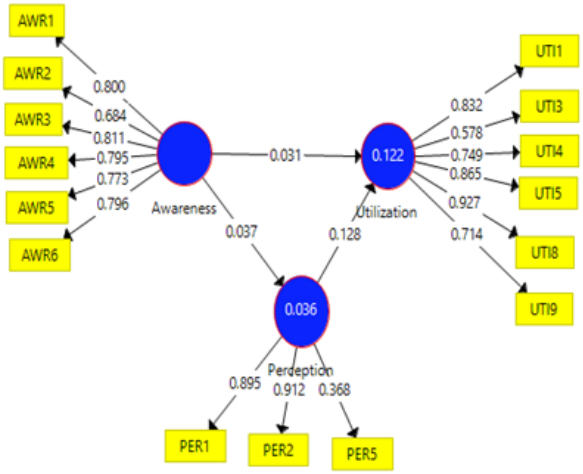

Figure 2: Structural Equation model connecting awareness, perception, and utilisation of AI in research.

Table 3 below showed that β=.341, 95%CI [.31,.37], t=21.392 p<.05). This shows statistical evidence that Hypothesis 6, which is on direct effect of perception on utilisation of AI tools in research, is rejected. Thus, the alternate hypotheses are supported for the three direct effects of awareness on perception, awareness on utilisation, and perception of utilisation of AI tools in research. The result of Hypothesis 7, as presented in Table 3, attempted to provide empirical evidence of the nexus between awareness and utilisation as mediated by perception and showed that (β =.065, 95%CI [.045,.081], t = 7.227, p<.05), which is an indication that perception provides a partial mediation between awareness and utilisation of AI tools in research. Thus, the null hypothesis is rejected.

Table 3: Direct and indirect effects.

Variables	β	95%CI	*M*	*SD*	*t*	*p*	Remarks
Awareness -> Perception	0.19	[.13 .23]	0.19	0.024	8.022	<.001	Rejected
Awareness -> Utilisation	-0.167	[-.22, -.06]	-0.162	0.039	4.263	<.001	Rejected
Perception -> Utilisation	0.341	[.31, .37]	0.342	0.016	21.392	<.001	Rejected
Awareness -> Perception -> Utilisation	0.065	[.046, .081]	0.065	0.009	7.227	<.001	Rejected

M=mean, SD=standard deviation, CI=Confidence interval

Gender differences in the nexus between the independent and dependent variables

A multi-group analysis was carried out to determine the difference among respondents by gender on the nexus between awareness and utilisation, perception and utilisation, as well as awareness and perception of AI research tools among students. The result, as presented in Table 4, for Hypothesis 8 revealed that students' awareness significantly predicts their perception of AI tools for research positively for both males (β=.54, t=5.105, p<.001) and females (β=.11, t=2.78, p<.001), with the effect being stronger on males. The permutation test found a significant gender difference (δ = -0.441, p<.001) in the prediction of awareness on students' perceptions of AI tools in research. Hypothesis 8, based on the result, was rejected. The results in Table 4 for Hypothesis 9 also showed that students' awareness significantly predicts their utilisation of AI tools in research positively for males (β =.11, t = 0.929, p <.05) but negatively for females (β = -.20, t = 9.772, p<.001), with the effect being stronger on the female students than the male students. The permutation test found a significant difference (δ=.108, p<.001) in how awareness contributes to students' utilisation of AI tools for research more in females than males. Therefore, our hypothesis was rejected. Similarly, the result in Table 4 for hypothesis 10 showed that perception significantly predicted their utilisation positively for both males (β=.30, t=2.096, p<.001) and females (β=.31, t=18.409, p<.001), with the effect being relatively stronger in females than the male students. The permutation test found a non-significant difference (δ = −.09, p >.05) in how perception contributes to students' utilisation of AI tools for research between males and females. Therefore, our hypothesis was sustained.

Hypothesis 11: Table 4 further shows that perception significantly mediated the nexus between students' awareness and utilisation of AI research tools, both positively for males (β=.17, t=1.980, p<.001) and females (β=.03, t=2.66, p<.001). The mediation effect was stronger for males than for female students. The permutation test reveals a significant difference (δ = −.187, p<.001) in the mediation

Table 4: Multi group analysis based on gender.

Variables	B	95%CI	*M*	*SD*	*t*	*p*
	Males					
Awareness -> Perception	0.539	[.48, .59]	0.53	0.106	5.105	<.001
Awareness -> Utilisation	0.106	[-.21, .25]	0.08	0.114	0.929	>.05
Perception -> Utilisation	0.308	[-.27, .38]	0.274	0.147	2.096	<.001
Awareness -> Perception -> Utilisation	0.166	[-.16, .20]	.144	0.840	1.980	<.004
	Females					
Awareness -> Perception	0.11	[.01, .17]	0.107	0.04	2.78	<.001
Awareness -> Utilisation	-0.202	[-.23, -.14]	-0.201	0.021	9.772	<.001
Perception -> Utilisation	0.311	[.28, .34]	0.312	0.017	18.409	<.001
Awareness -> Perception -> Utilisation	.0340	[.02, .05]	0.034	0.013	2.660	<.008
Permutation test of differences						
	Paths coefficient					
Paths coefficients	Baseline	Female	Males	Δ	95%CI	p
Awareness -> Perception	0.19	0.106	0.547	-0.441	[-.01, .16]	<.001
Awareness -> Utilisation	-0.167	-0.22	-0.329	0.108	[-.08, .08]	<.001
Perception -> Utilisation	0.341	0.302	0.40	-0.098	[.09, .02]	>.05
Awareness -> Perception -> Utilisation	0.065	0.032	0.219	-0.187	[-.03, .05]	<.001

M=mean, SD=standard deviation, CI=Confidence interval

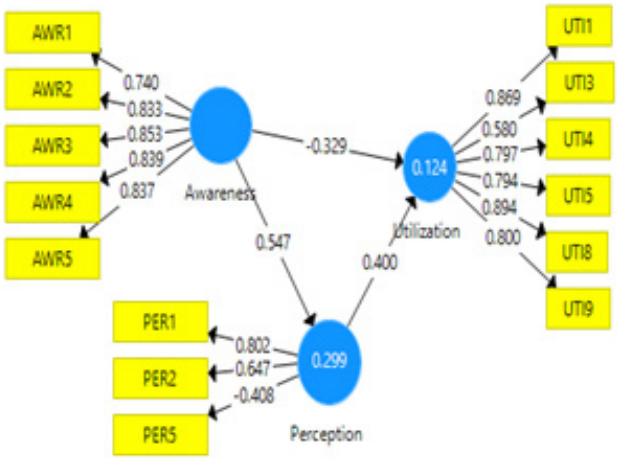

Figure 3a: Males.

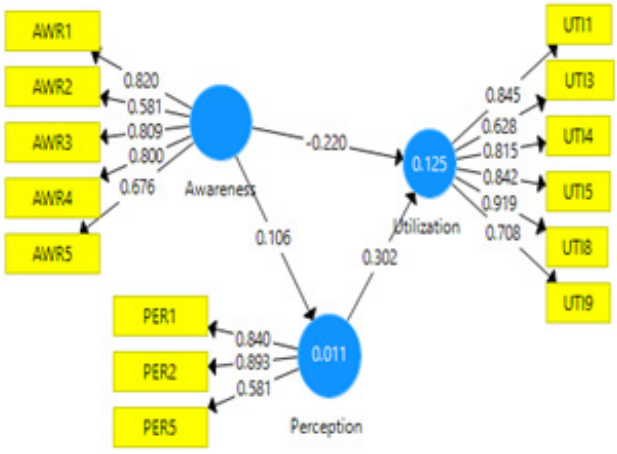

Figure 3b: Females.

effect of perception for both male and female respondents. Therefore, Hypothesis 11 was rejected. The result in Figure 3 further showed that awareness and perception, when combined, explain 12.4% of the variance (R^2=.124) in male students' utilisation of AI tools for research, while in

females, both variables, when combined, explain 12.5% of their utilisation of AI tools in research. Similarly, awareness explains 29.9% of the variance in male students' perceptions of AI tools, while for female students, it contributes only 1.1% of the variance in their perceptions of AI tools. This showed that students' awareness AI tools for research is stronger among the male students but lower among the female students in their perception of AI tools.

Type of programme in the nexus between the independent variables and dependent variables

The result as presented in Table 5 for Hypothesis 12 revealed that students' awareness significantly predicts their perception of AI tools for research negatively for undergraduates (β=. -0.27, t=2.444, p<.001), but positively for postgraduate students (β=.278, t=11.231, p<.001). The permutation test found a significant programme difference (δ = -.536, p <.001) in the prediction of awareness of students' perceptions of AI tools in research. Hypothesis 12, based on the result, was accepted. The results in Table 5 for Hypothesis 13 also showed that students' awareness significantly predicts their utilisation of AI tools in research negatively for undergraduates (β = -0.338, t = 17.74, p<.001) but positively for postgraduates (β = 0.168, t = 4.199, p<.001), with the effect being stronger among the postgraduate students than the undergraduate students. The permutation test found a significant difference (δ = -.506, p<.001) in how awareness contributes to students' utilisation of AI tools for research more in postgraduates than undergraduate students. Therefore, our alternate hypothesis was supported. Similarly, the result in Table 5 for Hypothesis 14 showed that perception significantly predicted their utilisation positively for both undergraduates (β=0.146, t=2.85, p<.001) and postgraduates (β= 0.385, t=16.987, p<.001), with the effect being stronger in postgraduates than the undergraduates' students. The permutation test found a significant difference (δ = -.239, p<.001) in how perception contributes to students' utilisation of AI tools for research between undergraduates and postgraduates. Therefore, our hypothesis was supported.

Hypothesis 15: Table 5 further shows that perception significantly mediated the nexus between students' awareness and utilisation of AI research tools negatively for undergraduates (β= -.04, t=4.067, p<.001) and positively for postgraduates (β=.103, t=9.497, p<.001). The mediation effect was stronger for postgraduates than for undergraduate students. The permutation test reveals a significant difference (δ = -.142, p<.001) in the mediation effect of perception for both undergraduate and postgraduate respondents. Therefore, Hypothesis 15 was rejected. The result in Figure 4a further showed that awareness and perception, when combined, explain 16.2% of the variance (R^2=.162) in undergraduate students' utilisation of AI tools for research, while in postgraduate students, both variables, when combined, explain 21.2% (R^2=.212) in their utilisation of AI tools in research. Similarly, awareness explains 7.2% (R^2=.072) variance among undergraduate students' perceptions of AI tools, while for postgraduate students, it contributes only 7.2% (R^2=.072) of the variance in their perceptions of AI tool research. This showed that students' awareness and perception of the utilisation of AI tools for research are stronger among postgraduate students, but there is a higher relative equality in the contribution of awareness to perception between postgraduate and undergraduate students.

Table 5: Multigroup analysis based on type of programme.

Variables	β	95%CI	*M*	*SD*	*t*	*p*
Undergraduate						
Awareness -> Perception	-0.268	[-.34, -.14]	-0.248	0.11	2.444	<.05
Awareness -> Utilisation	-0.338	[-.37, -.30]	-0.343	0.019	17.74	<.001
Perception -> Utilisation	0.146	[-.01, .21]	0.138	0.051	2.85	<.001
Awareness -> Perception -> Utilisation	-.040	[-.16, .20]	-.04	.010	4.067	<.001
Postgraduates						
Awareness -> Perception	0.268	[.21, .31]	0.268	0.024	11.231	<.001
Awareness -> Utilisation	0.168	[.08, .24]	0.167	0.04	4.199	<.001
Perception -> Utilisation	0.385	[.34, .43]	0.386	0.023	16.987	<.001
Awareness -> Perception -> Utilisation	0.103	[.02, .05]	0.104	0.011	9.497	<.000
Permutation test of differences						
Paths coefficient						
Paths coefficients	Baseline	UnderG	PostG	Δ	95% CI	p
Awareness -> Perception	0.19	-.268	.268	-.536	[-.13, .13]	<.001
Awareness -> Utilisation	-0.167	-.338	.168	-.506	[-.07, .07]	<001
Perception -> Utilisation	0.341	-.146	.385	-.239	[.06, .06]	<.001
Awareness -> Perception -> Utilisation	0.065	-.039	.103	-.142	[-.03, .04]	<.001

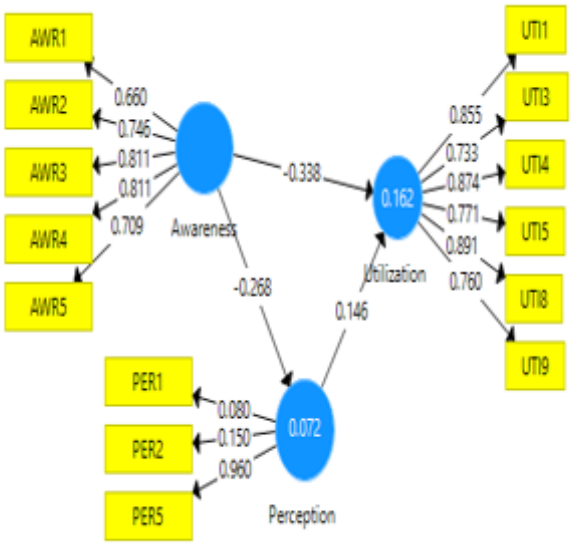

Figure 4a: Undergraduates.

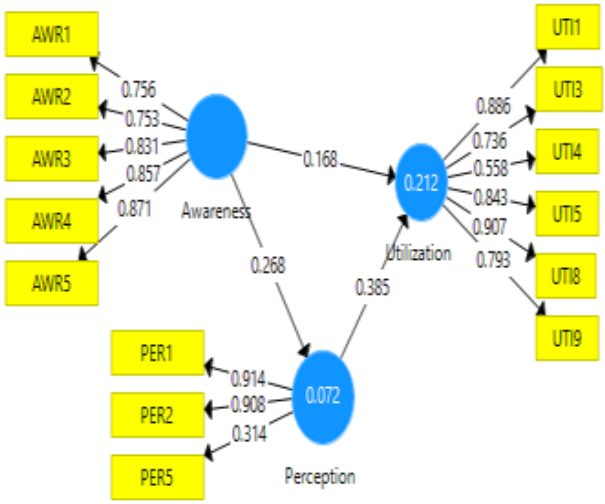

Figure 4b: Postgraduates.

Assessment of outer model

Figure 2 is the baseline model that provides information about the outer loadings of the individual items to the latent factors. The items loaded appropriately to the various factors except for item UT3 (.578) in utilisation and PER5 (.368) for perception, which loaded lower than .70, which according to Memon and Rahman (2014) are desirable. However, the items were considered desirable since the other assessment criteria were well-fitted, as reported in the study (Götz et al., 2009). In Figure 3, the outer loading for gender was examined, and the results revealed that the loading of two items ranged from .408 to .894, while for female loading, it ranged from .581 to .919. For undergraduate students, item loading ranged from .080 to .960, and for postgraduate students, item loading ranged from .314 to .907. Importantly, some items loaded poorly into the latent construct, such as items PER 1 and PER 2 for undergraduates and PER5 for postgraduate students. However, these items were not deleted since removing them from the model affected the reliability of each subscale. These items for the undereducated may not be suitable for students in those programmes.

Convergent validity

Convergent validity was established using the average variance extracted (AVE) for the measurement models in the study. It has been established that an AVE of 0.50 or above is adequate for achieving the convergent validity of a measure. The results in Table 6 revealed that all the variables, awareness, perception, and utilisation, obtained an AVE above .50, which is evidence that an AVE has been achieved. Similarly, for each group, gender, and type of programme as categorised, convergent validity was also achieved for males, females, undergraduates, and postgraduate students, but not for perception among undergraduate students.

Similarly, discriminant validity was assessed using the Fornell-Larcker criterion. It states that for discriminant validity to be achieved, the square root of the AVE for each construct must be greater than the coefficient of correlation among variables. The result in Table 7 presents empirical evidence of the discriminant validity of the constructs.

Table 6: Convergent validity of measures.

		Gender		Type of programme	
Variables	Baseline	Male	Female	Undergraduate	Postgraduate
Awareness	.847	.675	.552	.562	.664
Perception	.664	.509	.613	.417	.586
Utilisation	.899	.633	.638	.667	.634

Table 7: Discriminant validity of the measures.

							Female			Undergraduate			Postgraduate		
Variables	Baseline			Males											
Awareness (1)	**0.77**			**.82**			**.74**			**.75**			**.81**		
Perception (2)	0.21	**0.76**		.23	**.71**		.12	**.78**		.20	**.51**		.32	**.76**	
Utilisation (3)	-0.16	0.26	**0.79**	-.14	.33	**.79**	.29	-.13	**.79**	.18	-.16	**.82**	.28	.34	**.79**

HTMT. HTMT values were less than 0.90 which is an indication that discriminant validity evidence for the population is achieved by gender and programme type.

Reliability

Two measures were used in determining the reliability of the measurement models, which are Cronbach alpha and composite reliability coefficient. Table 8 shows that all the reliability estimates are greater than .70. Therefore, the three subfactors—awareness, perception, and utilisation—had reliability coefficients across males, females, and undergraduate and postgraduate student subgroups.

Table 8: Composite and Cronbach alpha reliability estimates.

	Baseline		Gender				Programme type			
			Males		Females		Undergraduate		Postgraduate	
	α	CR	α	CR	α	CR	α	CR	α	CR
Awareness	.847	.885	.879	.912	.830	.859	.805	.864	.875	.908
Perception	.764	.780	.708	.890	.773	.822	.705	.708	.778	.780
Utilisation	.899	.908	.895	.910	.900	.912	.901	.923	.998	.916

α =Cronbach alpha, CR=composite reliability

Discussion of findings

The result of the study showed that students in tertiary institutions are highly aware of AI in research. That is, they are aware of AI tools available for research. This level of awareness may relate to the rising popularity of AI among students in executing educational responsibilities. Studies have also shown that students spend a considerable amount of time with AI tools, especially ChatGPT, that have become very common in thesis writing, among others (Lattie et al., 2022). The study results also showed that male students have a stronger awareness of AI tools compared to female students. This aligns with previous studies showing that in Africa, the rising use of the internet for various purposes is more common among male' students, probably a result of cultural segregation that exists. In Africa, it is common that most of the students who are women are always assigned home responsibilities, and this may reduce their time to have the required awareness of the plethora of tools that are useful for research purposes (Odigwe & Owan, 2020; McGregor et al., 2017). The findings of the study also showed that postgraduate students are more aware of AI tools used in research than undergraduate students. This finding is not unconnected to the fact that the postgraduate programme is research-oriented, and students are often exploring different avenues to get literature, knowledge of statistical tools, and how to beat plagiarism in their work compilation. This is in line with previous findings that have stated that postgraduate students are more exposed to ICT usage than undergraduate students (Ozimek & Bierhoff, 2016). This could also be due to the nature of the course work that they do, which to a very great extent, requires diverse tools that are optimally useful in their work organisation and the accumulation of information that provides explanations for areas of difficulty in their research expeditions.

The result of Hypothesis Two revealed that students' perceptions of AI tools in research are positive. The alternate hypothesis is supported. That is, irrespective of the wide general perception that many people have about AI in education, both students have a positive perception of AI in research. This is in line with previous studies (Liang et al., 2021; Hwang & Tu, 2021) that have evidenced that AI is useful in education for the purposes of programmed

learning, assessment, data collection, and self-tutoring (Ouyang et al., 2022). This relevance of AI in the educational circle and the assistance that it may have provided may be the reason why they hold a positive perception of tools in research. The result further showed that male students have a stronger perception of AI tools in research than female students. The findings may be due to the fact that, given their level of awareness of what AI tools are used for, they are more comfortable using AI to perform several tasks in research than the traditional sources of knowledge that most of the female students consider tedious and boring. This study contradicts previous findings that posit that female students are more social media-oriented than male students (Gil-Clavel & Zagheni, 2019; Oberst et al., 2016). The consistency in the dominance of male students in terms of awareness and perception of AI calls for further research to provide more explanation on the rationale for these differences, given that students of both gender need these tools equitably for their research engagement. More so, the result for the type of programme showed that both postgraduate and undergraduate students have a positive perception of AI tools in research. Both groups may have understood the relevance of these tools in their academic and research engagements, and thus, they need to develop a positive perception of them to utilise them adequately. The result aligns with a few previous studies that showed that students' perceptions of ICT at both the undergraduate and postgraduate level are positive, given that it is necessary for maximum results in research expeditions (Zhao, 2022; Kurniati & Fithriani, 2022).

The result showed that students in Nigerian tertiary institutions utilise AI tools for research with very high esteem. The extent of these findings could be because of the wide applicability of technology in research in universities and the educational system. This result is not surprising because it is common that in all the iPhones, laptops, and other gadgets that are held by students, these apps and tools are installed since students are widely tutored by different social media spaces, among other platforms. This helps them to utilise the various platforms and tools that have become very beneficial in editing, paraphrasing, and providing plagiarism checks. Similarly, there may be other factors within the environment that may instigate students' high level of utilisation of AI tools in research. These include the rising importance of AI in instruction and self-directed instruction, among others (Almaraz-López et al., 2023).

Similarly, the general rising awareness of students about the importance of AI tools in education and the reports about their easy accessibility for information found in several useful f products may be another reason for students' high utilisation of these tools in research. However, contrary to expectations as defined by the cultural roles women play in Africa, women have a stronger level of utilisation compared to men. This contradicts earlier findings that male students are more involved in ICT usage compared to women (Christoph et al., 2015; Syed & Al-Rawi, 2023). The findings of the study may be connected to the fact that awareness is not utilised. One may be aware of AI tools but may lack the expertise and skills to utilise the various tools they are aware of. This could account for the differences because most of the female students in Nigerian universities hold sophisticated phones and laptops that most of the male students do not have access to. These may have boasted more utilisation of the AI tools in research than the male students. The study has further implications, and other researchers could also carry out similar studies to provide explanations as AI is becoming more relevant in the education system and academic research. The study results further showed that postgraduate students utilise AI tools in research more than undergraduate students. This is also not surprising because those who are in their master's and doctorate studies are more involved in the search for knowledge, either to expand their knowledge base of the variables selected for the study or to increase the weight of the evidence from previous studies. This keeps them perpetually utilising tools associated with AI in their pursuit of research quality. The findings are similar to those of previous studies (Utami et al., 2023).

The result of this study revealed that students' awareness of AI tools significantly predicts their direct effect on their perception of AI tools in research. The outcome of the findings could be that the knowledge students have about AI determines what they perceive about AI. Most students' knowledge about AI is negative. First, most students have been made to believe that AI tool utilisation makes them redundant and unable to think for themselves; therefore, they become very lackadaisical in their engagement with AI tools in research. They perceive the use of AI to be negative and thus limit what they should have done with such development. Similarly, the direct effect of awareness on perception could also be connected to the fact that students who may have a low level of awareness may not perceive AI tools in a good light. The multi-group analysis further showed that male students have stronger awareness when compared to female students in their perception of AI tools. This is due to the cultural differences that have been established concerning male and female roles in Africa (Christopher et al., 2015; Syed & Al-Rawi, 2023).

The result of this study revealed that students' perceptions of AI tools significantly predict the direct effect on their utilisation of AI. Students who hold a positive view about the relevance of AI and its applicability in research will optimally utilise it in order to produce quality research work. More so, when students' perception is positive, they believe so much in those tools, given that the tools may help them access materials, paraphrase their works, and carry out editing. However, when students have a negative perception of AI tools, they see it from a moral perspective and may not use the tools as much. The outcome of the findings could be possible in that the perception one holds about an object determines the utilisation of such objects. The multi-group analysis further showed that male students are not different from female students in their perception of AI tool utilisation. This is due to the cultural differences that have been established about male and female roles in Africa. (McGregor et al., 2017; Odigwe & Owan, 2020).

The result of this study revealed that students' awareness significantly predicts the direct effect on their utilisation of AI tools in research. The rationale for the study could be that students cannot use what they don't have knowledge of. The more they are aware of the various AI tools that can

help their research work, the more they utilise them for that purpose. Secondly, students who, on a daily basis, come into contact with tools that aid them in carrying out one research work or another are more inclined towards its utilisation. This is because they have seen the relevance in the quality of work that the tools facilitate them to produce. Therefore, they may devote more time to engaging these facilities and tools for optimum research outcomes. The nexus between awareness and utilisation of AI tools was also found to be stronger from the male side than the female side. This result is not unconnected to the fact that previous studies have already stated that male students are stronger in ICT compared to female students (Odigwe & Owan, 2020; Owan et al., 2021) in surfing, downloading, and printing materials. Similarly, with respect to the type of programme differences in the relationship between awareness and utilisation, the findings further showed that postgraduate students and undergraduate students are both aware of the relationship that exists in their utilisation of AI tools. This is because of the rising level of technology in the educational sector and students' introduction to ICT at both the undergraduate and postgraduate levels. This introduction has raised their awareness of the use of AI tools for research by both students. The findings are also in line with previous studies that have stated that students' discipline and programmes are relevant in their utilisation of AI tools based on their awareness and perception (Wang, 2022).

The result of hypothesis that focuses on the variance explained in both male and female students based on their collective contribution of perception and awareness on the utilisation could be explained from diverse perspectives. First, the total variance was higher in male students than the female students. This could be due to the fact that societal expectations may influence the way male and female students engaged in technology and develop awareness and perception of AI tools. This perception may be tied to their traditional roles that may help male students be more aware of these tools and invariably affecting their perception. More so, the educational environment may contribute to the different levels of awareness and understanding of the use of AI tools. There are some curricula that expose more males to AI-related tools than the female students. In this sense, the cultural background where female students are restricted to certain activities may also play a role in these differences in awareness and perception that favours more males. This is similar to the outcome of the study that was conducted by Owan et al. (2023).

The result of the nexus between awareness and utilisation of AI tools as mediated by perception showed that perception has positively but significantly mediated the link between awareness and utilisation of AI research tools. This result may be because perception is very important, even if the student is aware of the relevance of AI in research. Many students are often concerned about what the outcome of using AI will hold for them and their future. This may also be a result of private concerns, as most students are made to believe that AI tools can make them redundant and less human if used for various purposes. This supports the findings of previous studies documenting that AI tools are suited for research (Miranty & Widiati, 2021; Fahmi & Cahyono, 2021). Similarly, the multi-group analysis further showed that male students, who are stronger than female students in their awareness of AI tools, are also utilising them for their research. The findings are not far from showing that gender attitudes towards ICT are different. Most male students, especially now that the use of technology is diverse, are engaged deeply in it, especially in Africa, for diverse purposes. This may be the reason for the differences.

Limitations of the study

The study has some limitations, especially when the interpretation of the results is involved. First, the study was carried out only in universities in Nigeria, and this may affect the generalisation of the study to other institutions like monotechnics, colleges of education, and colleges of health technology that were not incorporated into the study. Further studies are important for cities and institutions in the country. Secondly, the study was purely a survey that involved self-reports, which are not without personal biases and prejudices in the pattern of responses. Observation methods or interview methods could be more accurate. Finally, the use of a longitudinal method rather than a cross-sectional survey will have been more appropriate to comprehend students' awareness and perception of AI tools in research over time. This will help us understand the changes that happen in a student's awareness and perception as they progress in their research activities and academic ladder. However, this is not to say that the findings of the study are useless, as they have helped to provide more insight into the level of awareness and perception of Nigerian university students regarding the utilisation of AI tools in research. It also highlights the differential effects of gender and type of programme shaping awareness, perception, and utilisation of AI tools. Further studies can be carried out to address the challenges identified in this study and to provide more explanation for the outcome of the study.

Conclusion

The conclusion drawn from this study is that students in Nigeria are highly aware of and have a positive perception of AI tools in research. The result also showed that the utilisation of AI is high among students. Students' level of awareness has a direct and significant effect on perception and utilisation of AI tools, with male students and postgraduates having stronger awareness of AI utilisation. Furthermore, students' perceptions of AI have a direct effect on their utilisation of AI, with a differentially stronger variation for male and postgraduate students than female and undereducated students. The findings are germane in that they have helped in providing more insight into students' use of AI based on variables like awareness and perception of these emerging technologies in research. The study contributes to AI promotion in existing literature in education. Therefore, the institutional technology base should be improved to enable students' access to free Wi-Fi so as to utilise AI tools for maximum research outcomes. There is a need for massive reorientation and sensitisation programmes that will provide students with the opportunity to handle media tools as well as learn how to utilise various research tools, especially among undergraduate students

whose awareness and perception are still very weak. The study also contributes to existing studies in that students who hold negative perceptions about AI tools will be more interested in engaging them through open access to internet-based platforms for quality research studies.

Acknowledgements

The researchers acknowledged all validators of the instrument for their active participation in the process. The class representatives of various programmes that formed WhatsApp platforms for this purpose are also appreciated. Similarly, the students who provided consent for this study are also well appreciated.

References

Adarkwah, M. A., & Huang, R. (2023). Technology addiction, abduction and adoption in higher education: Bird's eye view of the ICT4AD policy in Ghana 20 years on. *British Journal of Educational Technology, 54*(6), 1484-1504. https://doi.org/10.1111/bjet.13352

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionising education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology, 15*(3), Article 429. https://doi.org/10.30935/cedtech/13152

Aggarwal, C. C. (2018). *Neural networks and deep learning*. Springer. https://doi.org/10.1007/978-3-319-94463-0

Agyemang, M. A., Amponsah, S., Micheal, W. , Ronghuai, D.D., Ahmed T. B., Ahmed, H., & Huanhuan, W. (2023). Awareness and acceptance of ChatGPT as a generative conversational AI for transforming education by Ghanaian academics: A two-phase study. *Journal of Applied Learning & Teaching, 6*(2), 78-93. https://doi.org/10.37074/jalt.2023.6.2.26

Ahmet, G. & Aydemirb, F. (2020). Artificial Intelligence in education and schools. *Research on Education and Media, 12*(1), 13-21. https://doi.org/10.2478/rem-2020-0003

Alimi, A. E., Buraimoh, O. F., Aladesusi, G. A. & Babalola, E. O. (2021). University students' awareness of, access to, and use of artificial intelligence for learning in Kwara State. *Indonesian Journal of Teaching in Science, 1*(2), 91-104. https://ejournal.upi.edu/index.php/IJoTis

Alloghani, M., Al-Jumeily, D., Mustafna, J., Hussain, A., & Aljaaf, A. J. (2020). A systematic review on supervised and unsupervised machine learning algorithms for data science. In *Supervised and unsupervised learning for data science* (pp. 3–21). Springer, Cham. https://doi.org/10.1007/978-3-030-22475-2_1

Almaraz-López, C., Almaraz-Menéndez, F., López-Esteban, C. (2023). Comparative study of the attitudes and perceptions of university students in business administration and management and in education toward artificial intelligence. *Education Sciences, 13*(6), 609. https://doi.org/10.3390/educsci13060609.

Almelweth, H. (2022). The effectiveness of a proposed strategy for teaching Geography through artificial intelligence applications in developing secondary school students' higher-order thinking skills and achievement. *Pegem Journal of Education and Instruction, 12*(3), 169-176. https://doi.org/10.47750/pegegog.12.03.18

Arguson, A., Mabborang, M., & Paculanan, R. (2023). The acceptability of generative ai tools of selected senior high school teachers in schools divisions office-manila, philippines. *Journal of Artificial Intelligence, Machine Learning and Neural Network, 3*(6), 1-10. https://doi.org/10.55529/jaimlnn.36.1.10

Bingimlas, K. A. (2009). Barriers to the successful integration of ICT in teaching and learning environments: A review of the literature. *Eurasia Journal of Mathematics, Science and Technology Education, 5*(3), 235-245.

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioural research: A primer. *Frontiers in Public Health, 6*, 149. https://doi.org/10.3389/fpubh.2018.00149

Bonk, C. J., & Wiley, D. A. (2020). Preface: Reflections on the waves of emerging learning technologies. *Educational Technology Research and Development, 68*(4), 1595–1612. https://doi.org/10.1007/s11423-020-09809-x

Chen, Y., Jensen, S., Albert, L. J., Gupta, S., & Lee, T. (2023). Artificial intelligence (AI) student assistants in the classroom: Designing chatbots to support student success. *Information Systems Frontiers, 25*(1), 161-182. https://doi.org/10.1007/s10796-022-10291-4

Chiu, T. K. F., Meng, H., Chai, C. S., King, I., Wong, S., & Yeung, Y. (2022). Creation and evaluation of a pre-tertiary Artificial Intelligence (AI) curriculum. *IEEE Transactions on Education, 65*(1), 30-39. https://doi.org/10.1109/TE.2021.3085878

Christopher, M. S., Goerling, R. J., Rogers, B. S., Hunsinger, M., Baron, G., Bergman, A. L., & Zava, D. T. (2016). A pilot study evaluating the effectiveness of a mindfulness-based intervention on cortisol awakening response and health outcomes among law enforcement officers. *Journal of Police and Criminal Psychology, 31*, 15-28.

Chu, H., Tu, Y., & Yang, K. (2022). Roles and research trends of artificial intelligence in higher education: A systematic review of the top 50 most-cited articles. *Australasian Journal of Educational Technology, 38*(3), 22–42. https://doi.org/10.14742/ajet.7526

Chubb, J., Cowling, P., & Reed, D. (2022). Speeding up to keep up: Exploring the use of AI in the research process. *AI & Society, 37*(4), 1439-1457.

Clark, D. (2020). *Artificial ıntelligence for learning: How to use AI to support employee development.* Kogan Page Publishers.

Cohen, I. L., Liu, X., Hudson, M., Gillis, J., Cavalari, R. N., Romanczyk, R. G., ... & Gardner, J. M. (2017). Level 2

Screening with the PDD behavior inventory: Subgroup profiles and implications for differential diagnosis. *Canadian Journal of School Psychology, 32*(3-4), 299-315. https://doi.org/10.1177/0829573517 721127

Crawford, J., Cowling, M., & Allen, K. A. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching & Learning Practice, 20*(3), 2. https://doi.org/10.53761/1.20.3.02

Dessy Harisanty, E., Variant, A., Tesa, E., & Aji, A. (2022). *Leaders, practitioners and scientists' awareness of artificial intelligence in libraries: A pilot study*. https://www.emerald.com/insight/0737-8831.

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management, 71*, 102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Elliott, D., & Soifer, E. (2022). AI technologies, privacy, and security. *Frontiers in Artificial Intelligence, 5*, 826737. https://doi.org/10.3389/frai.2022.826737

Fahmi, M. A., & Cahyono, B. Y. (2021). EFL students' perception on the use of Grammarly and teacher feedback. *JEES Journal of English Educators Society, 6*(1), 18–25. https://doi.org/10.21070/jees.v6i1.849

Federal Ministry of Health (2017). *National health research ethics committee*. http://www.nhrec.net

Gao, C. A., Howard, F. M., Markov, N. S., Dyer, E. C., Ramesh, S., Luo, Y., & Pearson, A. T. (2022). *Comparing scientific abstracts generated by ChatGPT to original abstracts using an artificial intelligence output detector, plagiarism detector, and blinded human reviewers*. BioRxiv. https://doi.org/10.1101/2022.12.23.521610

Gasaymeh, A. (2018). A study of undergraduate students' use of information and communication technology (ICT) and the factors affecting their use: A developing country perspective. *EURASIA Journal of Mathematics, Science and Technology Education, 14*(5), 1731-1746.

Gil-Clavel, S., & Zagheni, E. (2019). Demographic differentials in Facebook usage around the world. *Proceedings of the International AAAI Conference on Web and Social Media, 13*(01), 647-650. https://doi.org/10.1609/icwsm.v13i01.3263

Götz, D., Laurent, P., Lebrun, F., Daigne, F., & Bošnjak, Z. (2009) variable polarization measured in the prompt emission of GRB 041219a using IBIS on board integral. *The Astrophysical Journal, 695*(2). https://arxiv.org/abs/0903.1712

Häkkinen, P., Järvelä, S., Mäkitalo-Siegl, K., Ahonen, A., Näykki, P., & Valtonen, T. (2017). Preparing teacher students for 21st century learning practices (PREP 21): A framework for enhancing collaborative problem solving and strategic learning skills. *Teachers and Teaching: Theory and Practice, 23*(1), 25–41. https://doi.org/10.1080/13540602.2016.1203772

Hefernan, N. T., & Hefernan, C. L. (2014). The ASSISTments ecosystem: Building a platform that brings scientists and teachers together for minimally invasive research on human learning and teaching. *International Journal of Artificial Intelligence in Education, 24*(4), 470–497. https://doi.org/10.1007/ s40593-014-0024-x

Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P., & Romero-Rodríguez, J. M. (2019). Artificial intelligence in higher education: A bibliometric study on its impact in the scientific literature. *Education Sciences, 9*(1), 51. https://doi.org/10.3390/educsci9010051

Hu, Y., & Min, H. K. (2023). The dark side of artificial intelligence in service: The "watching-eye" effect and privacy concerns. *International Journal of Hospitality Management, 110*, 103437. https://doi.org/10.1016/j.ijhm.2023.103437

Huang, A. Y., Lu, O. H., & Yang, S. J. (2023a). Effects of artificial intelligence-enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom. *Computers & Education, 194,* 104684. https://doi.org/10.1016/j.compedu.2022.104684

Hwang, G. J., & Tu, Y. F. (2021). Roles and research trends of artificial intelligence in mathematics education: A bibliometric mapping analysis and systematic review. *Mathematics, 9*(6), 584. https://doi.org/10.3390/math9060584

Ifelebuegu, A. O., Kulume, P., & Cherukut, P. (2023). Chatbots and AI in Education (AIEd) tools: The good, the bad, and the ugly. *Journal of Applied Learning and Teaching, 6*(2), 332-345. https://doi.org/10.37074/jalt.2023.6.2.29

Ismail, C., Muhterem, D., Hanni, M. & Sanna, J. (2022). The promises and challenges of artificial intelligence for teachers: A systematic review of research. *TechTrends, 66,* 616–630. https://doi.org/10.1007/s11528-022-00715-y

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., ... Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103*, 102274. https://doi.org/10.1016/j.lindif.2023.1022744.

Kelly, A., Sullivan, M., & Strampel, K. (2023). Generative artificial intelligence: University student awareness, experience, and confidence in use across disciplines. *Journal of University Teaching & Learning Practice, 20*(6), 12. https://doi.org/10.53761/1.20.6.12

Kelly, M. S. (2023, January 26). ChatGPT passes exams from law and business schools. *CNN*. https://edition.cnn.com/2023/01/26/tech/chatgpt-passes-exams/index.html

Khan, I., Ahmad, A. R., Jabeur, N., & Mahdi, M. N. (2021).

An artificial intelligence approach to monitor student performance and devise preventive measures. *Smart Learning Environments, 8*(1), 1-18. https://doi.org/10.1186/s40561-021- 00161-y

Khanagar, S., Alkathiri, M., Alhamlan, R., Alyami, K., Alhejazi, M., & Alghamdi, A. (2021). Knowledge, attitudes, and perceptions of dental students towards artificial intelligence in Riyadh, Saudi Arabia. *Medical Science, 25*(114), 1857–1867.

Kung, T. H., Cheatham, M., Medenilla, A., Sillos, C., De Leon, L., Elepaño, C., Madriaga, M., Aggabao, R., Diaz-Candido, G., Maningo, J., & Tseng, V. (2023). Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. *PLoS Digital Health, 2*(2), e0000198. https://doi.org/10.1371/journal.pdig.0000198

Kurniati, E. Y., & Fithriani, R. (2022). Post-graduate students' perceptions of Quillbot utilization in English academic writing class. *Journal of English Language Teaching and Linguistics, 7*(3), 437–451. https://doi. org/10.21462/jeltl.v7i3.852

Langran, E., Searson, M., Knezek, G., & Christensen, R. (2020). AI in Teacher Education. In D. Schmidt-Crawford (Ed.), *Society for information technology & teacher education international conference* (pp. 735–740). Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/p/215821/

Lattie, E. G., Stiles-Shields, C. & Graham, A. K. (2022). An overview of and recommendations for more accessible digital mental health services. *Nature Reviews Psychology, 1*, 87–100. https://doi.org/10.1038/s44159-021-00003-1

Li, K., Zhou, C., Luo, X. R., Benitez, J., & Liao, Q. (2022). Impact of information timeliness and richness on public engagement on social media during COVID-19 pandemic: An empirical investigation based on NLP and machine learning. *Decision Support Systems, 162*, 113752. https://doi.org/10.1016/j.dss.2022.113752

Li, Z. (2022). Factors influencing students' continuous willingness to use e-learning platforms in higher education. *International Journal of Information and Communication Technology Education (IJICTE), 18*(3), 1-11. https://doi.org/10.4018/IJICTE.313424

Liang, J. C., Hwang, G. J., Chen, M. R. A., & Darmawansah, D. (2021). Roles and research foci of artificial intelligence in language education: An integrated bibliographic analysis and systematic review approach. *Interactive Learning Environments*. https://doi.org/10.1080/10494820.2021.1958348

Limna, P., Kraiwanit, T., Jangjarat, K., Klayklung, P., & Chocksathaporn, P. (2023). The use of ChatGPT in the digital era: Perspectives on chatbot implementation. *Journal of Applied Learning and Teaching, 6*(1), 64-74. https://doi.org/10.37074/jalt.2023.6.1.32

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. http://discovery.ucl.ac.uk/1475756/

Lund, B. D., Wang, T., Mannuru, N. R., Nie, B., Shimray, S., & Wang, Z. (2023). ChatGPT and a new academic reality: Artificial Intelligence-written research papers and the ethics of the large language models in scholarly publishing. *Journal of the Association for Information Science and Technology, 74*(5), 570-581. http://dx.doi.org/10.1002/asi.24750

McGregor, S. C., Lawrence, R. G., & Cardona, A. (2017). Personalisation, gender, and social media: Gubernatorial candidates' social media strategies. *Information, Communication & Society, 20*(2), 264-283. https://doi.org/10.1080/1369118X.2016.1167228

Memon, A. H., Rahman, I. A., Abdullah, M. R., & Azis, A. A. A. (2014). Factors affecting construction cost performance in project management projects: Case of MARA large projects. *International Journal of Civil Engineering and Built Environment, 1,* 30-35.

Mertala, P., Fagerlund, J., & Calderon, O. (2022). Finnish 5th and 6th grade students' pre-instructional conceptions of artificial intelligence (AI) and their implications for AI literacy education. *Computers and Education: Artificial Intelligence, 3*. https://doi.org/10.1016/j.caeai.2022.100095

Mesagan, F. O., Eseadi, C., & Omekwu, C. O. (2022). Influence of gender and expected competencies on access to and utilisation of cyberspace resources and services for research by postgraduate students. *Education and Information Technologies, 27*, 6157–6171. https://doi.org/10.1007/s10639-021-10878-5

Miranty, D., & Widiati, U. (2021). An automated writing evaluation (AWE) in higher education. *Pegem Journal of Education and Instruction, 11*(4), 126–137. https:// doi.org/10.47750/pegegog.11.04.12

Mogavi, R. H., Deng, C., Kim, J. J., Zhou, P., Kwon, Y. D., Metwally, A. H. S., ... & Hui, P. (2023). *Exploring user perspectives on chatgpt: Applications, perceptions, and implications for ai-integrated education*. arXiv preprint arXiv:2305.13114.

Nazaretsky, T., Ariely, M., Cukurova, M., & Alexandron, G. (2022). Teachers' trust in AI-powered educational technology and a professional development program to improve it. *British Journal of Educational Technology, 53*(4), 914-931. https://doi.org/10.1111/bjet.13232

Oberst, U., Wegmann, E., Stodt, B., Brand, M., & Chamarro, A. (2016). Negative consequences from heavy social networking in adolescents: The mediating role of fear of missing out. *Journal of Adolescence, 55*, 51-60.

Odigwe, F. N., & Owan, V. J. (2020). Academic staff personal variables and utilisation of ICT resources for research, teaching and records management in higher education. *The European Conference on Education 2020: Official Conference Proceedings*. https://doi.org/10.22492/issn.2188-1162.2020.11

Okada, A., Whitelock, D., Holmes, W., & Edwards, C. (2019). E-authentication for online assessment: A mixed-method study. *British Journal of Educational Technology, 50*(2), 861–

875.

Ouyang, F., Zheng, L., & Jiao, P. (2022). Artificial intelligence in online higher education: A systematic review of empirical research from 2011–2020. *Education and Information Technologies, 27*, 7893–7925. https://doi.org/10.1007/s10639-022-10925-9

Owan, V. J., Obla, M. E., Asuquo, M. E, Owan, M. V., Okenjom, G. P., Undie, S. U., Ogar, J. O., & Udeh, K. V. (2023). Students' awareness, willingness and utilisation of facebook for research data collection: Multigroup analysis with age and gender as control variables. *Journal of Pedagogical Research, 7*(4), 369-399. https://doi.org/10.33902/JPR.202322235.

Owan, V. J., Abang, B. A., Idika, D. O., Etta, E. O. & Bassey, B. A. (2023) Exploring the potential of artificial intelligence tools in educational measurement and assessment. *EURASIA Journal of Mathematics, Science and Technology Education, 7*(4), em2307. https://doi.org/10.29333/ejmste/13428

Owan, V. J., Agurokpon, D., & Udida, U. J. (2022). *Curriculum restructuring and job creation among Nigerian graduates: The mediating role of emerging Internet applications*. SSRN 4009822.

Ozimek, P., & Bierhoff, H.-W. (2016). Facebook use depending on age: The influence of social comparisons. *Computers in Human Behavior, 61*, 271–279. https://doi.org/10.1016/j.chb.2016.03.034

Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning, 12*(1), 1-13. https://doi.org/10.1186/s41039-017-0062-8

Popenici, S., Rudolph, J., Tan, S., & Tan, S. (2023). A critical perspective on generative AI and learning futures. An interview with Stefan Popenici. *Journal of Applied Learning and Teaching, 6*(2), 311-331. https://doi.org/10.37074/jalt.2023.6.2.5

Qadir, J. (2022). *Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for education*. TechRxiv. https://doi.org/10. 36227/techrxiv.21789434.v1

Qin, F., Li, K., & Yan, J. (2020). Understanding user trust in artificial intelligence-based educational systems: Evidence from China. *British Journal of Educational Technology, 51*(5), 1693–1710. https://doi.org/10.1111/bjet.12994

Rasul, T., Nair, S., Kalendra, D., Robin, M., Santini, F. O., Ladeira, W.J., Sun, M.W.., Day, I., Rather, A.R., & Heathcote, L. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. *Journal of Applied Learning & Teaching, 6*(1), 41-56. https://doi.org/10.37074/jalt.2023.6.1.29

Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? *Journal of Applied Learning and Teaching, 6*(1), 342-363. https://doi.org/10.37074/jalt. 2023.6.1.29

Saura, J. R., Ribeiro-Soriano, D., & Palacios-Marqués, D. (2022). Assessing behavioral data science privacy issues in government artificial intelligence deployment. *Government Information Quarterly, 39*(4), 101679. https://doi.org/10.1016/j.giq.2022. 101679

Seufert, S., Guggemos, J., & Sailer, M. (2020). Technology-related knowledge, skills, and attitudes of pre-and in-service teachers: The current situation and emerging trends. *Computers in Human Behavior, 115*, 106552. https://doi.org/10.1016/j.chb.2020.106552

Swiecki, Z., Ruis, A. R., Gautam, D., Rus, V., & Williamson Shafer, D. (2019). Understanding when students are active-in-thinking through modeling-in-context. *British Journal of Educational Technology, 50*(5), 2346–2364. https://doi.org/10.1111/bjet. 12869

Syed, W., & Al-Rawi, M. (2023). Assessment of awareness, perceptions, and opinions towards artificial intelligence among healthcare students in Riyadh, Saudi Arabia. *Medicina 59*, 828. https://doi.org/10.3390/ medicina59050828

Vij, S., Tayal, D., & Jain, A. (2020). A machine learning approach for automated evaluation of short answers using text similarity based on WordNet graphs. *Wireless Personal Communications, 111*(2), 1271–1282. https://doi.org/10.1007/s11277-019-06913-x

Wang, T., Lund, B. D., Marengo, A., Pagano, A., Mannuru, N. R., Teel, Z. A., & Pange, J. (2023). Exploring the potential impact of artificial intelligence (ai) on international students in higher education: Generative ai, chatbots, analytics, and international student success. *Applied Sciences, 13*(11), 6716. https:// doi.org/10.3390/app13116716

Wang, Z. (2022). Computer-assisted EFL writing and evaluations based on artificial intelligence: A case from a college reading and writing course. *Library Hi Tech, 40*(1), 80–97. https://doi.org/10.1108/lht-05-2020- 0113

Xames, M. D., & Shefa, J. (2023). ChatGPT for research and publication: Opportunities and challenges. *Journal of Applied Learning and Teaching, 6*(1), 390-395. https://doi.org/10.37074/jalt.2023.6.1.20

Yang, Y., Liu, Y., Lv, X., Ai, J., & Li, Y. (2022). Anthropomorphism and customers' willingness to use artificial intelligence service agents. *Journal of Hospitality Marketing & Management, 31*(1), 1-23.

Yelena, D., Rakhila, A., Botagoz, Y., Tulekova, M., Pigovayeva, N., & Samal, A. (2022). *Artificial intelligence awareness levels of students.* https://doi.org/10.3991/ijet.v17i18.32195.

Yuan, S., He, T., Huang, H., Hou, R., & Wang, M. (2020). Automated Chinese essay scoring based on deep learning. CMC-Computers *Materials & Continua, 65*(1), 817–833. https://doi.org/10.32604/ cmc.2020.010471

Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., Alavi-Majd, H., & Nikanfar, A.-R. (2015). Design and implementation content validity study: Development of an

instrument for measuring patient centred communication. *Journal of Caring Sciences, 4*(2), 165–178. https://doi.org/10.15171/jcs.2015.017

Zhao, X. (2022). Leveraging artificial intelligence (AI) technology for English writing: Introducing wordtune as a digital writing assistant for EFL writers. *RELC Journal,* 00336882221094089. https://doi.org/10. 1177/00336882221094089